PLATE XIV.

FIG. 1.—*Orbitoides papyracea* (Boubée).
- *a.* Lateral aspect. Magnified 5 diameters.
- *b.* Periphero-lateral aspect. Ditto.
- *c.* Horizontal median section. Magnified 20 diameters.
- *d.* Central transverse section. Ditto.

FIG. 2.—*Orbitoides dispansa* (Sowerby).
- *a.* Lateral aspect. Magnified 6 diameters.
- *b.* Periphero-lateral aspect. Ditto.
- *c.* Central transverse section. Magnified 20 diameters.

FIG. 3.—*Orbitoides Sumatrensis*, sp. nov.
- *a.* Lateral aspect. Magnified 6 diameters.
- *b.* Periphero-lateral aspect. Ditto.
- *c.* Horizontal section, near the median plane. Magnified 35 diameters.

III.—ON THE LIMITS OF THE YOREDALE SERIES IN THE NORTH OF ENGLAND.[1]

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WHEN a group of beds has well-defined boundaries above and below, and when moreover its palæontological characteristics coincide with its stratigraphical limits, it becomes a boon alike to the field-geologist and to the fossil collector. When, on the other hand, both limits and fossils fail to enable one to follow a group beyond a certain point, the sooner the series as such is relegated to the limbo of purely-local, convenient, but untrue divisions, the better. I propose to show in this paper that the important group of beds commonly known as the Yoredale Series in the North-Western parts of Yorkshire is a group of the latter kind, convenient indeed in that district, but quite incapable of being traced much further North either stratigraphically or palæontologically.

I cannot find a more concise definition of what is usually meant by the term "Yoredale Series" than that given by my friend Prof. Nicholson.[2] He says: "The *Yoredale Series* of Phillips, the Upper Limestone or Limestone-shale series of some authors, consists of numerous alternating beds of limestone, sandstone, grit, and shale, with a few thin and worthless seams of coal, the whole attaining a thickness of 500 feet, according to Mr. Forster. The two most constant members of the Yoredale Series are the 'Tyne-bottom Limestone,' and the 'Main,' 'Great,' or 'Twelve-fathom' Limestone, respectively the lowest and the highest limestones of the group. As regards Cumberland and Westmorland, the Yoredale Series is best studied in Alston Moor, in Teesdale, and along the summit of the Pennine Escarpment; but for its fullest development we must look to the valleys and hills of Yorkshire, where it was originally described by Prof. Phillips, and where it sometimes attains a thickness of 1000 feet." Now this set of beds is bounded above by the Millstone-grit, and below by the Scar Limestone

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[1] Read at the Bristol Meeting of the British Association, 1st September, 1875.

[2] Essay on the Geology of Cumberland and Westmorland, by H. A. Nicholson, D.Sc., F.G.S., etc., London and Manchester, 1868, p. 79.

Series, from which, however, it is separated by a sheet of basaltic trap well known in the North of England as the Great Whin Sill. It is to this lower limit that I wish to call particular attention.

Granting that no stratigraphical boundary could be more convenient than one marked by a non-intrusive, continuous, evenly-interbedded mass of trap, especially when we remember that, even in its typical localities, the Scar Limestone Series is (setting fossil evidence aside) only distinguished from the upper group by the thickness of its beds of limestone—granting this, it must yet be obvious that each one of these conditions is essential to the arrangement. If the basalt be shown to be intrusive, that is, injected among, and not merely over, hardened beds, if it be discontinuous in any portion of its course, if it shift its horizon to higher or lower portions of the Carboniferous mass, then this trap utterly fails as a natural divisional line.

Now in a paper read at the Bradford Meeting of the British Association in 1873[1] by my friend Mr. W. Topley, F.G.S., and myself, which has yet only been printed in abstract, we showed, I believe quite conclusively even to the late Prof. Phillips, who had formerly upheld the opposite view, that in its career across Northumberland to the North Sea the Great Whin Sill was distinctly and undoubtedly intrusive, that it was occasionally discontinuous, and that it was subject to changes of level so important as in some cases to carry it to a position *above* that very "Main" or "Great" Limestone which, as is stated in the quotation above, is one of the highest beds in the Yoredale Series. It is needless to repeat the detailed descriptions by which we established these facts, as the paper will probably before long be published in full; but if any scepticism remain on the subject, I would call attention to a section[2] which, in the words of one very competent to form an opinion, "satisfactorily clears up even to the most fastidious person the intrusive character of the rock."[3]

It is true that the Whin Sill in Durham and along the great Pennine Escarpment is wonderfully regular, and can, for those portions of its extent, be looked upon as, for all practical purposes, the equivalent of a truly interbedded or contemporaneous trap, although even there the signs of its intrusive nature were sufficient to convince so experienced an eye as that of the late Prof. Sedgwick. But surely the mere fact that north of Alston Moor its horizon cannot be depended on for any distance *along its outcrop,* is sufficient to throw the gravest doubt on the Basaltic sheet's continued geological horizon to the dip or eastern side. There is no reason to believe that an intrusive sheet of trap in which great and frequent shifts of level in one part of its area have been proved, would lie persistently between the same beds in any other part of it, even if the examination of its outcrop in the latter region have revealed no change of horizon. Slight variations of level, however, seem to be admitted by some of the upholders of the interbedded character of the Whin Sill, even south of Northumberland.[1]

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[1] On the Whin Sill of Northumberland, by W. Topley, F.G.S., and G. A. Lebour, F.G.S. (Abstract in Report of the British Association for 1873, London, 1874, part 2, p. 92).

[2] On the 'Great' and 'Four-Fathom' Limestones and their associated beds in South Northumberland, by G. A. Lebour, F.G.S., etc., Trans. N. Engl. Inst. of Min. Eng., 1875, vol. xxiv. p. 140, and fig. i. pl. xxxiii.

[3] Mr. R. Howse, in discussion on above paper, *ibid.* p. 147.

In arguing this point in conversation, I have sometimes been met with the objection that the Great Whin Sill was not really taken as the boundary between the Yoredale Series and the Scar Limestone Series, but that the bed of limestone lying upon it in the Alston District and along the Pennine Escarpment was taken as the bottom Yoredâle bed—this limestone being well known in the lead-mining districts as the "Tyne-bottom Limestone"—without reference to the trap, whose absence or presence had but an accidental connexion with the line of division. I believe that this ingenious way of shuffling out of the difficulty is of quite recent invention—dating, in fact, from the time when the true nature of the Whin Sill was conclusively shown. That it is so will be made apparent by a glance at the most authoritative geological maps of England which have appeared of late years. In them the Yoredales and the Scar, or Carboniferous Limestone proper, divisions will be found very clearly defined by a continuous red divisional line of Basalt—the Great Whin Sill—without a hint of any other demarcation being sought.[2] Again, passages such as the following, which testify similarly to the general acceptance of the trap-sheet as a base-line, might be multiplied with ease, viz. "YOREDALE ROCKS.—In this series we include all the strata from the Fell-top Limestone inclusive to the Great Whin Sill."[3]

My position then, with regard to the Great Whin Sill, is this: that being undoubtedly intrusive and subject to change of level, it is totally unfit to serve as the boundary line between two great divisions of the Carboniferous rocks.

Setting aside the great trap-sheet therefore, and seeking for a less fickle base for the Yoredale rocks in the North, we have offered us merely a bed of Limestone—the Tyne-bottom Limestone of the Alston miners.

This "Tyne-bottom Limestone" is the tenth calcareous bed mentioned by Westgarth Forster (in descending order) in his section of the strata of the Alston Moor District. It has no lithological character to distinguish it from the other limestones, either higher in the Yoredales above it, or in the Scar Series below; its thickness (about 22 feet) is not constant, even over a limited district; its fossils are useless for purposes of identification. Indeed, no bed perhaps in the entire Carboniferous Limestone Series in the North of England is more difficult of identification—certainly none has had so many other beds taken for it. The reason of this is simply that, with the rooted belief that the Great Whin Sill was a regularly interbedded trap-flow, whatever calcareous band chanced to be found next above it was instantly supposed to be the Tyne-bottom Limestone. This identification was sometimes right and sometimes wrong (more often the latter), and it necessarily led to great confusion respecting the horizons of the beds above.[1] In the faulted district which lies to the North of Alston it would be a difficult thing to trace with any certainty a line of boundary depending on an ill-characterized bed such as this; but in this case the difficulty becomes almost an impossibility if we bring the following considerations to bear upon the subject.

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[1] Nicholson, *op. jam. cit.*, p. 78.

[2] The geological map which accompanies the Coal Commission Report is an exception, although in that map the assumed doubtful line of boundary between Yoredale and Scar is more out than usual, owing, doubtless, to the general character of the map.

[3] A Synopsis of the Geology of Durham and Part of Northumberland, by Richard Howse and J. W. Kirkby, Newcastle-on-Tyne, 1863, p. 22.

It is no part of the object of this paper to describe in detail the beds which form the so-called Yoredale Series in Northumberland; but it is necessary, for a proper understanding of my argument, that I should refer to a paper in which I have shown that the several beds of limestone which make up the calcareous element of the series in the Alston District increase in number in its northern extension, that not only limestones of average thickness, but also grits, shales, and coals appear, and sometimes disappear, as intercalated beds of greater or less continuity.[2]

The Yoredales, which in the Alston District are about 500 feet thick, in about twenty miles of northerly trend increase to some 2000 feet, only a few of the more marked beds being traceable throughout. Among these the Tyne-bottom Limestone has no place. No one but a Wernerian miner, relying on the golden rule of thumb, could at the end of the twenty miles point out with any degree of certainty the bed which is indeed the "Tyne-bottom." It may be there, or it may have thinned out, as many others have been proved to do. At any rate, here is no fit base for a great stratigraphical division. In the Pennine Escarpment, however unphilosophical and unnatural the line might be shown to be, it is a convenient one. Here in mid-Northumberland it has not even that recommendation. No doubt a nearly correct approximate horizon could easily be found marking the level of the Tyne-bottom bed. But what would such an approximate line divide?

Above it, from 1000 to 2000 feet of grits, shales and limestones, and thin coals; below it, a much greater mass of grits, shales, limestones, and thin coals, similar in every respect to the series above. Similar lithologically, similar in the individual thicknesses of its beds (for the thick limestones of the Scar Series have disappeared by this time), and similar in fossils. Of what use can such a division be?

Nearly all the organisms which it was supposed characterized the Yoredales in Northumberland have now been found in the lower beds of the Carboniferous Series,[1] and the massive calcareous formation which sufficiently distinguishes the Scar Series to the south has given place in the west of this county to a mere extension below of the Yoredale Series above. In a sense it would be correct to say that in Northumberland the Yoredale Series is the only part of the Carboniferous Series below the Millstone-grit present, with the exception of the Calciferous Sandstone, or Tuedian, group.

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[1] The Scar beds are not supposed to be worth much for lead-mining purposes, and are therefore, with a few striking exceptions, seldom worked into.

[2] On the "Little Limestone" and its Accompanying Coal in South Northumberland, by G. A. Lebour, Trans. N. Engl. Inst. Min. Eng. 1875, vol. xxiv. p. 1, *et seq.*

But only in a very limited sense would this be true. When Prof. de Koninck, in receiving the Wollaston Gold Medal of the Geological Society in February last, took occasion to state, or rather to imply perhaps, that the faunas of the Carboniferous Limestone Series of the North of England and of Scotland were identical with that of the Calcaire de Visé (the uppermost of his three Belgian divisions),[2] he no doubt said so in this limited sense. Palæontologically there is no break in the northernmost part of England between the Scar and the Yoredale Series, but this only means that the circumstances of life and of deposition were in this region free from the changes which in the south determined those groupings of Carboniferous organisms which mark off into clear stages the Carboniferous Limestone as a whole. These northern beds are not the Yoredales alone, increased to an enormous thickness. They are the Yoredales *plus* the Scar Limestone, rendered indistinguishable by the geographical features of their time. They as truly represent the Tournai and the Dinant as they do the Visé division, although they may be homotaxeous with the last alone. The life conditions of Visé lasted in Northumberland from the close of the Calciferous or Tuedian age to the time of the Millstone-grit, or possibly to the beginning of the Coal-measure Period. Thus it is that in that part of England the Yoredales, the Scar Series, etc., are mere names without significance.

"In fact," as Prof. Ramsay has so well said, "viewed as a whole, the Carboniferous Series consists only of one great formation, possessing different lithological characters in different areas, these having been ruled by circumstances dependent on whether the strata were formed in deep, clear, open seas, or near land, or actually, as in the case of the vegetable matter that forms the coals, on the land itself."[3]

Since then no Yoredales proper and no Scar Limestones proper can be shown to exist, as such, in the great Carboniferous Limestone Series of Northumberland, and since no comprehensive name has been given to the blending of these two divisions which forms the link between the Yorkshire and the Scottish types of the series, and which is developed to its fullest extent in Northumberland, some special name denoting this series must sooner or later be coined. May I venture to suggest "Bernician Series" as a suitable term for these—the beds which in Northumberland lie between the Tuedian (or better *Valentian*, Geikie, MS.) Rocks and the Millstone-grit? The term explains itself, and gives no handle to theoretical misapplication.

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[1] Up to the present time, the well-marked foraminifer *Saccammina Carteri*, Brady, is apparently limited to a bed in the Upper or Yoredale part of the series, viz. the Four-fathom Limestone.

[2] Abstract of Proc. of the Geol. Soc. of London, No. 296, p. 2.

[3] Physical Geology and Geography of Great Britain, by A. C. Ramsay, LL.D., F.R.S., 2nd edition, 1872, p. 76.

IV.—NOTES ON WEST INDIAN FOSSILS.

By W. M. GABB,
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ON my return to civilization, after an absence of nearly three years, I observe in the GEOLOGICAL MAGAZINE for 1874, New Series, Decade II. Vol. I., pp. 404 and 433, a paper by Mr. R. J. L. Guppy, of Trinidad, describing new species of fossils from the West Indian Tertiaries, to which is appended a list of the fossils known to him up to that date. Unfortunately Mr. Guppy has overlooked my Memoir on the Geology of Santo Domingo, published in the Transactions of the American Philosophical Society more than a year before the date of his paper. In that paper I nearly doubled the list of known fossils in the West Indian Miocene, basing my determinations on a collection of unprecedented magnitude, made during the prosecution of the Geological Survey of the Dominican Republic. Although ignorant of the existence of this paper, Mr. Guppy has been fortunate in not redescribing any of the species contained in it, so far as I can make out, save with the following exceptions:

Phos erectus, Guppy, GEOL. MAG. Pl. XVI. Fig. 1, is the species described by me under the name of *P. Guppyi*, in recognition of that gentleman's extensive labours in the region.

I had previously pointed out that the shell described by Sowerby as *Conus solidus*, and re-named by Mr. Guppy as *C. recognitus*, is identical with Reeve's *pyriformis*.

Turritella planigyrata, G., is common in Santo Domingo, and Mr. Guppy's description must be amplified so as to cover individuals quite heavily, but always evenly ribbed.

I cannot indorse the suggestion of a new generic name for *Gouldia*, even granting the pre-occupation of the old name among birds. Numerous precedents exist for retaining the old, well-known name; and a following out of the same idea would create much more confusion in nomenclature than it would obviate.

I append a list of the fossil corals belonging to the Geological Survey Collection, and recently determined by Count Pourtales.

List of Fossil Corals collected by W. M. Gabb, Esq., in Santo Domingo.

By L. F. POURTALES.

The following list comprises all the fossil corals collected by Mr. Gabb in Santo Domingo. The greater number are stated to be from the Miocene, a few from the Post-Pliocene, and fewer yet from the Cretaceous. The latter are very much altered by fossilization, while among the former, many are in an excellent state of preservation.

The determination is of course based on the valuable papers on West Indian fossil corals, published by Prof. P. M. Duncan, F.R.S., in the Quarterly Journal of the Geological Society. A few forms ap-